Present Claims	Comment
21	New, but derived from claim 1
22	Identical to claim 2
23	Identical to claim 3
24	Identical to claim 4
25	Identical to claim 5
26	New, but based on claim 6
27	New, but based on claim 7
28	Identical to claim 8
29	New, but based on claim 9
30	Identical to claim 10
31	Identical to claim 11
32	Identical to claim 12
33	New, but based on claim 13
34	Identical to claim 14
35	New, but based on claim 15
36	Identical to claim 16
37	Identical to claim 17
38	Identical to claim 18
39	Identical to claim 19
40	New, but based on claim 20

The Rejection of Claims 1 through 13 and 15-19 under 35 U.S.C. 103(a) as unpatentable over Riza is overcome.

Paragraph No. 2 of the Office Action states that claims 1-12 are rejected, but the actual rejection covers claims 1-13 and 15-19. Claims 1 through 13 and 15-19 were rejected under 35 U.S.C. 103(a) as unpatentable over Riza on the

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basis that Riza's system can be modified to incorporate image comparison for the purpose of pattern recognition. While this rejection was thought to be improper, independent claim 1 has been replaced with claim 21 which sharpens the distinction over Riza.

Applicants request reconsideration of this rejection as applied to the new claims because they recite novel physical features. These novel physical distinctions are submitted to be unobvious under §103.

Applicants' Identification System

Applicants identification system employs a polychromatic light source with a short coherence length to identify and study structures which lie beneath the surface of a subject's fingernail. Their test beam is preferably swept across the subject's nail by means of a galvanometric mirror scanner. They orient the polarization vectors of their test and reference beams at ninety degrees with respect to one another, and in addition orient the polarization vectors of these beams with respect to the surface being studied. They also include a structure to adjust for path length difference in their test and reference beams. This adjustment is required in order to map the vertical extent of the birefringent Malpighian layer in the subject's nailbed.

Riza

Riza, on the other hand, shows a laser-based interferometric system with non-mechanical beam scanning. Acousto-optic devices or Bragg cells implement optical scanning of a test medium. Laser light has essentially infinite coherence length. He does not orient the polarization vectors of his test and reference beams at ninety degrees with respect to one another. Further, the polarization vectors of these beams are not oriented in any particular direction with respect to the surface being studied. In addition, because of the long coherence length in his system,

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Riza includes no structure to adjust for path length differences in his test and reference beams.

Applicants' Identification System is Generally Different from Riza's

Applicants' recognition or identification system is specifically designed to detect a three-dimensional structure within the birefringent material adjacent the epidermal folds within a nailbed. This requires use of a light source with a very short coherence length, between five and ten microns. This coherence region is a small fraction of the height of the ridge structures in the subject's nailbed. Applicants' reference reflector moves the coherence region over a distance greater than the height of the ridge structures, thereby enabling mapping of these structures. Riza, on the other hand, uses laser light with an essentially infinite coherence length, many times the height of the subject's nailbed ridge structures. It is not possible for him to move his coherence region within a subject's nailbed since it cannot be contained therein. Therefore he cannot discern any structure within a subject's nailbed.

Applicants' system requires that the polarization of the test and reference beams be oriented at ninety degrees with respect to each other, or "crossed". It further requires that the polarizations of the beams be oriented properly with respect to the epidermal folds in the subject's nailbed. Applicants' figure 11 shows a 45-degree orientation of the incident and reference beams with respect to the nailbed. On the other hand, Riza's test and reference beams are reflected from the same Faraday rotator, therefore the polarization vectors in Riza are parallel, not crossed. In addition, Riza does not orient the polarization of his test and reference beams with respect to the surface or object being studied.

In Applicants' system, the reflected beam and the reference beam finally impinge together on a single photodetector in the optical processor. In Riza, "One photodetector acts as the fixed phase reference, while another fixed photodetector

picks up the test medium phase information as the optical beam scans the test region."

In Applicants' system, only those components with path lengths which differ by less than the coherence length are important in the present measurement. Those components with path length differences greater than the coherence length contribute a steady-state term which is neglected in the mathematical analysis which discerns the structure of the subject's epidermal folds. When the incident and reference beams interfere, i.e. their path lengths differ by less than the coherence length, the amplitude of the beat frequency $\Delta\omega$ present at the output of the optical processor increases. The amplitude of this frequency component is maximum when the path lengths are equal. Thus Applicants seek an amplitude peak which occurs only within the very short coherence length of their light source. By noting the positions at which the path lengths are equal, the relative position of the reflector in the optical processor, and the position of the incident beam traversing the nailbed, it is possible to accurately map the epidermal folds in the nailbed. Thresholding of this beat frequency signal is done since only its maximum is of interest. On the other hand, Riza does not threshold his data. He cannot do so because of his large coherence length. All reflections are important in Riza, not just those within a limited coherence length.

Applicants deliberately use an other-than-laser light source in their measurement system in order to reduce the coherence length of their light source. An additional benefit of this choice lies in safety and removal of the need for inspection and regulation of Applicants' equipment. Applicants' system exposes a subject's digit to the illumination used in determining the subject's identity. If laser light were used in Applicants' system, as in Riza, the possibility of radiation injury to a digit, or to an eye from accidental reflection, exists. Public safety has required implementation of safety standards for laser emission. Equipment which employs lasers must be certified for safety and warning labels must be posted to protect the public from harm. Omission of the laser in Applicants' system results

in a system which is inherently safe to use and removes the requirements for certification and posting warning labels. The expenses of obtaining safety certification and printing warning labels is absent in Applicants' device, reducing its cost of manufacture.

Thus Applicants' system is generally very different from Riza's.

Claim 21 Defines Novel Subject Matter Over Riza

Claim 21 more distinctly defines over Riza. Claim 21 recites the following novel limitations over Riza:

"A system for determining the identity of a pattern on an area, comprising:

a. a light source other than a laser, having a predetermined spectral bandwidth for producing a collimated beam of light,"

Riza does not use a light source other than a laser but uses only laser illumination in all embodiments, and depends on the long coherence length inherent with laser illumination.

"f. a plurality of crossed polarizers for polarizing said respective plurality of beams,"

While Riza passes laser beams through polarizers, the polarizers associated with each beam are not crossed with respect to one another.

"g. a directional coupler for reflecting, and redirecting the reflection of said one of said beams,"

Riza does not use a directional coupler for reflecting and redirecting the reflection of any single beam.

"l. said data processor containing a pattern recognition algorithm for comparing previously-stored data with data from said electronic processor,"

Riza does not use a data processor containing a pattern recognition algorithm for comparing previously-stored data with data from an electronic processor.

"m. said pattern recognition algorithm also arranged to provide an indication of the identity of said pattern based on comparing said previously-stored data with said data from said electronic processor."

Riza does not employ a pattern recognition algorithm which is arranged to provide an indication of the identity of the pattern based on a comparison with previously stored data.

Therefore Applicants submit that claim 21 clearly has at least five important elements which each distinguish over Riza under §102.

Dependent Claims 22 to 32 Also Define Over Riza under §102.

Dependent claims 22 to 32 also define over Riza since they incorporate all of the limitations of claim 21. Also, several of these claims are independently patentable over Riza for the following reasons:

Dependent claim 22 recites:

"The system of claim 21 wherein said light source is a light-emitting diode."

Riza uses only laser illumination, with its inherently very long coherence length, in all embodiments. A light-emitting diode, with its inherently short coherence length, would not work in Riza's system.

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Dependent claim 23 recites:

> "The system of claim 21 wherein said light source is a bandpass-filtered, incandescent lamp."

Again, Riza uses only laser illumination in all embodiments, and requires its inherent very long coherence length for his system to work. A bandpass-filtered, incandescent lamp would not work in Riza's system.

Further, with regard to dependent claims 24 and 25 (formerly claims 4 and 5), the quoted section of the reference (col. 6, lines 33-42) does not teach what the Examiner relies upon it as supposedly teaching. The Office Action states that Riza discloses the following limitations of claims 24 and 25:

> "said modulating frequency source is arranged to modulate a first of said acousto-optic modulators at a first frequency; modulating frequency shifter is arranged to shift the frequency from said modulating frequency source and apply said shifted frequency to a second of said acousto-optic modulators, as claimed."

The reference states:

> "The invention further includes a first acousto-optical device having a first channel for selectively deflecting a first portion of the first beam in accordance with a first frequency in a first direction and a second channel for selectively deflecting a first portion of the second beam in accordance with a second frequency in first direction, wherein the difference between the first and second frequencies is fixed and a second portion of the first and second beams are not deflected by the first acousto-optical device."

Applicants apply a base frequency and a shifted frequency to their optical processor for purposes of *detecting* the reflected signal from the subject's nail bed. Riza, on the other hand, applies first and second frequencies to two acousto-

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optic modulators for purposes of *deflecting* first and second portions of his beam at different frequencies.

Thus claims 24 and 25, which are dependent on independent claim 20, recite significant novel limitations and are *a fortiori* patentable over Riza.

Dependent claim 26 recites:

> "26. (New) The system of claim 21 wherein a first of said polarizers is arranged to polarize light from the first of said acousto-optic modulators, and a second of said polarizers is arranged to polarize light from the second of said acousto-optic modulators, the angles of polarization of said first and second polarizers being separated by ninety degrees."

As stated above in connection with independent claim 21, Riza passes laser beams through polarizers. However the polarizers associated with each beam are not crossed with respect to one another. If this were the case, Riza's system would not work as described.

New independent claim 35 also distinguishes over Riza. Claim 35 recites:

"**35.** A method for determining the identity of a pattern on an area, comprising:

a. scanning said area with a scanning beam of light from a source other than a laser, having a predetermined spectral bandwidth to provide a reflected beam,"

Riza uses only laser illumination in all embodiments, and depends on the long coherence length inherent with laser illumination.

"b. providing a reference beam of light having a predetermined bandwidth,"

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Riza uses laser illumination with its inherently infinitesimal bandwidth. He relies on this characteristic illumination provided by a laser, rather than using a broadband source with a known, predetermined bandwidth.

"c. providing an analysis system containing previously stored pattern recognition data,"

Riza does not employ an analysis system containing previously stored pattern recognition data.

"e. providing said analysis to a pattern recognition algorithm,"

Riza does not provide an analysis to a pattern recognition algorithm.

"f. using said algorithm to compare the results of said analysis with said previously stored pattern recognition data, so as to provide a comparison,"

Riza does not use an algorithm to compare the results of an analysis with previously stored pattern recognition data.

"g. using said comparison to identify said pattern."

Riza does not use a comparison to identify a pattern.

In addition, the claims which are dependent upon claim 35 incorporate the limitations of claim 35 and add additional limitations and thus *a fortiori* distinguish over Riza under 35 U.S.C. 102.

Claims 21 to 34 also distinguish over Riza under 35 U.S.C. 103

For reasons stated, claims 21 to 34 recite novel features which distinguish over Riza under 35 U.S.C. 102. These novel features of claims 21 and 35 and their dependent claims also are unobvious over Riza under 35 U.S.C. 103 since these novel features

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produce new and unexpected results, and thus it would not be obvious to modify Riza to come up with Applicants' invention.

It Would Not Be Possible to Modify Riza's System to Come Up with Applicants' System

The Office Action indicated that Applicants' system, as claimed, differed from Riza's, but that it would be obvious to modify Riza's system to come up with Applicants' invention.

The Office Action admits that Riza fails to disclose a plurality of polarizers for polarizing a respective plurality of beams. (Applicants' claims recite a plurality of polarizers. In addition, the claims recite that the axes of these polarizers are crossed, which is impossible without a plurality of polarizers.)

The Office Action further stated that Riza's "light has total polarization and rotation". In fact, the cited lines (col. 10, lines 24-26) state: "The QWP (or the Faraday rotator) 27a imparts a total polarization rotation of 90° on the resulting reflected test and reference beams." Riza passes his test and reference beams through a *single* Quarter-Wave Plate (or Faraday rotator), thus rotating the polarization of *both beams* by 90 degrees. Applicants, on the other hand, employ two polarizers, resulting in test and reference beams which are rotated 90 degrees *with respect to each other*.

It would not be possible to modify Riza to come up with Applicants' identification system because Riza does not use crossed polarizers, as Applicants do. Riza uses laser light, with its attendant very long coherence region. If Riza were to use polychromatic light with a coherence region between five and ten microns, the usefulness of his system would be severely limited and would apply only to objects with height less than this. Applicants first locate the subject's Malpighian layer by using their optical and electronic processors. This places the coherence region within the Malpighian layer. Then they scan across the layer using a beam scanner. It would not be possible to modify Riza to do this since the

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coherence region of laser light is far greater than the height of the Malpighian layer and no structure could be discerned.

Further, there is no suggestion in Riza or any other prior art reference which teaches that Riza can or should be modified to use crossed polarizers, polychromatic light, mechanical beam scanners, and the like.

New and Unexpected Results

Because of its novel features, Applicants' system is able to locate and discern the Malpighian structure within the subjects' nailbed. None of the prior-art systems is capable of doing this, nor can they be modified to perform this function.

The rejection of claims 14 and 20 under 35 U.S.C. 103(a) as being unpatentable over Riza (US 5,694,216) in view of Brady (US 5,892,838) is overcome.

Claims 14 and 20 were rejected under 35 U.S.C. 103(a) as being unpatentable over Riza in view of Brady on the basis that it would have been obvious to one of ordinary skill in the art at the time of the invention to modify Riza's system by introducing the known features of identity verification of the individual by simply fingernail pattern comparison to identify the individual.

Applicants submit that these references cannot be physically and operationally combined, and even if combined the combination would not be operational. Riza could indeed examine the external fingernail pattern of an individual. However, as explained above, he could not discern the epidermal folds contained within a subject's nail.

In column 2, lines 15-17 Brady acknowledges the deficiency of fingernail examination for the purpose of biometric identification. The external fingernail pattern of an individual is subject to change over time. The surface of a nail is easily changed by abrasion, addition of grooves, coatings of nail polish or other substances, and the like. Although Riza could study the exterior surface of a nail,

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the data gathered would be uncertain and therefore far inferior to Applicants' in biometric identification.

Applicants' invention: Because of its structure and short coherence length illumination, Applicants system can study the interior structure of a subject's nail. It is impossible for subjects to change their identity by modifying this structure, except by causing significant, painful damage to the nail bed. The volume of data required to reliably identify an individual on the basis of the spacing of their epidermal folds is very small, perhaps a few bytes. Two-dimensional data are taken in order to average out minor meanderings of the folds as they progress axially down the nailbed. The averaged data are reduced to a single line across a subject's nailbed containing the relative spacings of the epidermal folds. In this sense, the data are much like a familiar barcode. Applicants' data are compact and very simple.

Brady: Brady shows a biometric recognition system employing a neural network. He dismisses fingernail patterns and goes on to study fingerprints. The volume of data required is very large. Brady must study and store information related to the positions, lengths, and angles of lines, ridge endings and bifurcations, and whorls contained in a fingerprint. He uses a neural network to analyze this very complex mixture of data. Brady's data set is very large and complex.

There Is No Justification for Combining Brady with Riza

There is no reason in the references themselves which suggest they can be combined. Each reference is complete in and of itself and does not indicate that any of its parts can be substituted elsewhere or replaced. The Office Action does not provide any valid reason for combining Brady with Riza, as suggested. Therefore Applicants submit that the proposed combination is unjustified and

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improper. In addition, the fact that the invention provides a new principle of operation in an old and crowded art also militates in favor of patentability.

The References Cannot be Operatively Combined

While Riza could theoretically be combined with Brady, such a combination would be an inoperative kluge or extremely inefficient and awkward, and would not be like Applicants' invention. In such a combination Riza would simply analyze and report the ridge structures of a subject's fingerprint to Brady's neural network. Applicants' system is superior because it has the capability to discern structure within the subject's nailbed, not just on the surface where surface features can change with time. A combination of Brady and Riza would be inoperative within the nailbed. Further, Brady cannot store information in as compact a form as Applicants do. Applicants can reliably identify an individual on the basis of a few bytes of data. Brady requires much more information; therefore he would require more data storage volume and more computing power to identify an individual.

Claims 34 and 40 Define Novel Subject Matter Over Riza and Brady

Even if Riza were to be combined with Brady, claims 34 and 40 would still define novel subject matter over the inferior and inoperative combination.

Claim 34 recites:

> "The system of claim 21 wherein said area is a fingernail of an individual, whereby said system can recognize the identity of said individual."

Riza and Brady study only features contained on the surface of an object. Applicants study features contained within a subject's nailbed, beneath the surface of the nail.

Claim 40 recites:

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"A system for determining the identity of an individual, comprising:

a. means for scanning a beam of polarized light within the nail bed of an individual to provide a reflected beam,"

Riza and Brady study only the surface of a reflecting object, not features within an object.

"b. means for analyzing said reflected beam,"

Riza and Brady study reflected beams from the surface of a reflecting object, not beams reflected from within an object.

The Novel Features are of Patentable Merit

The above novel features of claim 34 and 40 and their dependent claims are of patentable merit because Applicants' system has substantial advantages over Riza, Brady, or any combination thereof. Applicants' system suffers from none of the drawbacks of Riza and Brady. Applicants' system provides positive identification of an individual based on characteristics which are internal to the subject's nails. Riza cannot do this, and even if given Applicants' data, Brady's neural network would require far more computing power, and therefore expense, to arrive at the identity of an individual.

Therefore Applicants submit that claims 34 and 40 are patentable and should be allowed.

Conclusion

For all the above reasons, Applicant submits that all claims clearly recite substantial novel subject matter which is also unobvious because the novel claimed structure produces valuable and important new and unexpected results. Therefore Applicants submit that this application is now in full condition for allowance, which they respectfully solicit.

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Conditional Request for Constructive Assistance

If for any reason the Examiner feels that the present application is not yet in full condition for full allowance, Applicants, pro-se inventors, respectfully request appropriate guidance in prosecuting this application. I.e., Applicants respectfully request that the Examiner draft one or more claims, pursuant to MPEP 707.07(j) or provide constructive assistance pursuant to MPEP 2173.02, if the present claims are not fully acceptable. The Examiner is authorized to make any necessary minor changes.

Very respectfully,

Allen Topping

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Applicants Pro Se

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I certify that I have mailed this amendment to GAU 2623 of the United States Patent and Trademark Office on the date below.

Date: 4 December 2002 Allen W Topping

Allen Topping, First-Named Applicant